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File Code: 3420 **Date:** July 26, 2007
Route To: (2400)

Subject: Decomposition of Fire-killed Snags

To: District Ranger, North Kaibab Ranger District

I recently talked to Paul Callaway, Timber Manager, about the decomposition of snags and development of hazard trees in the Warm Fire burn area. The fire has killed numerous trees adjacent to Forest Service roads and hiking trails. The risk of dead trees or falling tops and branches hitting someone increases as snags degrade. This letter offers details on the decomposition process of fire-killed trees in the Warm Fire Hazard Tree Removal Project.

Once a tree is dead, decay processes degrade the structural integrity of trees quickly. Although there are generalities of the decay process, the rate at which particular trees decay and rate at which they fall to the ground vary. Some of the major factors known to affect decomposition and failure rate of snags include tree species, tree size, wind storms, and soil moisture. In general, ponderosa pine and true firs have quicker decomposition and fall rates than Douglas fir[i]. Larger trees take longer to decay and may loose their tops rather than falling at the base. A wind storm helps topple decaying snags[ii] and moisture rich soils aid the advancement of decay fungi.

The primary agents causing deterioration are fungi and insects, especially wood borers, with a succession of types and species changing from year to year until no sound wood remains. In fire-killed trees, the process starts just under the bark and progresses rather uniformly toward the pith. In general, most activity during the first year is from blue stain and incipient decay and results in very little structural degradation[iii]. By the end of the second year, degradation of the sapwood can be complete, but depends largely upon the thickness of sapwood, tree species, size, and site factors. By the end of the third year, practically no sapwood is sound, especially in smaller trees and the tops of larger trees. The outer heartwood also has appreciable deterioration in some trees.

Within two years branches and twigs of fire-killed trees drop in heavy storms, dead foliage falls, and some loose bark is evident in the tops of small trees. In the third year, evidence that the stand is breaking up becomes clear. Some smaller trees (10 to 12 inches in diameter) break off at various heights from the ground. The outer ends of smaller branches break and fall, thin bark becomes loose on small trees and in the tops of larger trees, and some bark drops off.

In the fourth and fifth years, many ponderosa pines and white firs of small size break off at ground level or up to 50 or more feet above the ground. Even some of the larger trees of these species and smaller trees of Douglas-fir will break off by the fifth year[iv]. After the fifth year, the general breakup continues until only scattered barkless snags and stubs remain. The last remnants of a stand are straight, large diameter trees in denser clumps[v].

Some exceptions to this general pattern of breakup occur at high elevation and on dry sites where decay in the upper bole is arrested by drying. Fungi are active only near the base of the tree,

where moisture from the ground is sufficient to permit decay. Dead trees then rot off at or near the ground and drop full length, rather than piece by piece from the top. Therefore, where moisture limits decay, the larger and thicker barked trees may be among the first to drop, and the smaller, thin-barked trees may be the surviving remnants of the stand.

A hazard tree is defined as a tree which has both a defect that would allow it to fail and a target (i.e. people or property) that it would hit when it fails. We know that most fire-killed trees **will** fail within 3-4 years. However, the removal of hazard trees needs to occur while it is still safe for a sawyer to cut the tree without the threat of injury. Dead trees that are determined to be hazardous need to be cut within the first year or two for the safety of the public and employees.

Another hazard tree concern following fires that may apply is the potential for blow down of living green trees in high recreation areas. This can occur in areas adjacent to severely burned areas where living trees have not developed to be wind firm and may have recently lost fine root structure from the fire. These trees tend to topple during strong wind storms when soils are very moist. This phenomenon is not easy to predict, but temporary closures can be made if trees start to fall within a particular area.

Mary Lou is available for further assistance if you would like her input. Please do not hesitate to call me at (928) 556-2075 if you have any questions.

/s/ Mary Lou Fairweather
MARY LOU FAIRWEATHER
Forest Pathologist, Forest Health, Arizona Zone

cc: Paul C Callaway
Stephen F Boyer
John Anhold
Debra Allen-Reid
Gilbert Zepeda

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[i] Hadfield, J.S., Magelssen, R.W., 2000. Wood Changes in fire-killed Eastern Washington: Tree Species—year five progress report. Unpublished report on File at USDA Forest Service Wenatchee National Forest, Wenatchee Service Center, Wenatchee, WA.

[ii] Schmid, J.M., S.A. Mata, W.F. McCambridge. 1985. Natural falling of beetle-killed ponderosa pine. Res. Note RM-454. Fort Collins, CO: Rocky Mountain Research Station, Forest Service, U.S. Department of Agriculture; 3 p.

[iii] Kimmey, J.W., 1955. Rate of deterioration of fire-killed timber in California. USDA Forest Service, California Forest and Range Experiment Station, Circular No. 962. 22 pp.

[iv] Passovoy, M.D., Fule, P.Z., 2005. Snag and woody debris dynamics following severe wildfires in northern Arizona ponderosa pine forests. For. Ecol. Manage. 223, 237-246.

[v] Chambers, C.L., Mast, J.N., 2005. Ponderosa pine snag daynamics and cavity excavation following wildfire in northern Arizona. For. Ecol. Manage. 216, 227-240.